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Evaluation of Some Potato Varieties and Breeding Lines for Resistance to Early Blight

By MURIEL J. O'BRIEN, *pathologist,* and R. V. AKELEY,[1] *horticulturist, Plant Science Research Division, Agricultural Research Service*

INTRODUCTION

Early blight, caused by *Alternaria solani* (Ell. & G. Martin) Sor., is found in most areas where potato, *Solanum tuberosum* L., is grown. It can cause extensive damage to plants by attacking both leaves and tubers. It causes a target-type leaf spot on leaves and some chlorosis. The fungus occurs mostly on the older often senescent leaves, causing defoliation with consequent reduction in yield. In addition, the fungus causes small, shallow, decayed lesions on tubers. The diseased area is raised around the edge of these sunken lesions. Saprophytes enter the shallow lesions and often complete the rotting of tubers.

Losses caused by *A. solani* infection can be economically disastrous in some years, particularly in the late summer and fall crops where irrigation is used. Genetic field resistance to the disease would be desirable as a means of biological control.

Because reservoirs of genetic resistance to, or immunity from, early blight might be present in the American Variety Collection and in the advanced seedling selections in the potato-breeding project of the U.S. Department of Agriculture, a greenhouse screening program was instituted to locate this resistance. The screening program began with 500 lines and all the named varieties in the Collection in the winter of 1968 at Plant Industry Station, Beltsville, Md. Based on these preliminary data, lines were selected for rescreening. The data reported here are from the replicated, second screening test conducted in the winter of 1969.

[1] Retired. Now horticulturist and associate professor, University of Maine, Aroostook State Farm, Presque Isle, Maine.

SCREENING TECHNIQUE

Screening is by spray-inoculation technique. In this technique a heavily sporulating culture, an isolate from White Rose variety, is maintained on Difco lima bean agar [2] dispensed in petri plates. These plates are exposed to approximately 200 ft.c. fluorescent light in a cycle of 8 hours of light to 16 hours of dark period. A lesser light intensity of 75 to 100 ft.c. light, however, is sufficient, to keep the culture sporulating.

Plants to be screened are grown in soil beds in the greenhouse. The soil is fertilized with 5-10-5 fertilizer mixture and additional fertilizer is applied as the plants mature. When the plants are 5- to 6-weeks old and about 16 to 20 in. tall, they are inoculated.

The source of the inoculum is 10-day-old plates of *A. solani*. Our heavily sporulating culture produced spores in quantity. When the test plants were ready to be inoculated the spores and mycelia were scraped from the agar surface of the plates. These scrapings were then ground in sterile distilled water in a Waring Blendor to disperse the spores and macerate the mycelial strands and the agar fragments. The resulting slurry was then filtered through two layers of 60- or 80-mesh cheesecloth into large, clean, glass containers with wide surface areas and incubated at 27° C. for 2 to 3 hours. Germination was checked, and the spore count made with a Bright Line Haemicytometer The inoculum was adjusted to permit a spore-load application of approximately 200,000 spores per milliliter.

Spore inoculum was dispensed in DeVilbiss spray bottles. The velocity of the spray was set at about 7 pounds pressure using a Klemm (electrically powered) Sprayer. The inoculum was distributed as uniformly as possible on the lower, older leaves of the plant. Inoculations were made about 3 hours before sunset when the stomata were wide open, with the spray directed to the underside of the leaves.

After the plants were inoculated, the greenhouse beds were completely covered with plastic sheets of 4-mil thickness. These sheets were removed at 8 a.m. the day after primary inoculation. On two or more successive evenings after initial inoculation, the plants were then sprayed with a very fine mist water spray and

[2] Trade names for products and equipment are used in this publication to provide specific information on our test procedures. The use of these trade names does not constitute a guarantee of the product or equipment named and does not signify that the items are approved by the U.S. Department of Agriculture to the exclusion of other similar items.

again covered with plastic. Thus, a moist-chamber effect was created to simulate field conditions of dew formation during the evening and night and the drying off of this moisture during the day. On the evenings that the plants were inoculated the temperature in the greenhouse was set at 27° to 29° C. (80°-85° F.) and lowered to 21° to 24° C. (70°-75° F.) during the day.

Resistance or susceptibility was measured using a 6-point rating scale—0 to 5, with 0 = no disease and 5 = plant dead.

Data reported are for a randomized test of two plants per clone in a complete block design replicated four times.

MATERIALS AND RESULTS

Two types of material were screened: (1) Named released varieties carried in the American Variety Collection, and (2) unnamed advanced seedlings with good horticultural characteristics. The variety Kennebec was used as the susceptible variety and Saco as the resistant check.

The presence of the disease in the inoculated plants was noted as early as 36 to 48 hours after inoculation. Under greenhouse conditions, typical symptoms of the disease—widening of the infection site and target-ring formation—often appeared late in the progress of the diseases, if at all. However, lines with some resistance showed only a hypersensitive reaction, or an immune reaction, similar to the reaction noted in the Saco check variety. The relative resistances are given in table 1.

Degrees of disease reaction on leaves are shown in figure 1. Figure 2 shows the overall screening setup in the greenhouse.

Four lines that had a zero (immune) rating in the 1968 preliminary test [3] proved resistant in the 1969 test: BR 5951-3, B 5461-4, B 6038-1, and B 6039-1. These lines had resistant ratings lower than the resistant check variety, Saco.

The data for the 19 varieties and 68 breeding lines screened in 1969 show that wide variability in resistance exists among these selections. There was no significant difference in resistance among 14 varieties and 55 selections. Because of this variability, more discrete levels of resistance in our breeding lines might be uncovered by altering the testing procedures, such as by screening more plants per clone, adjusting the spore load, and using a wider rating scale.

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[3] U.S. AGRICULTURAL RESEARCH SERVICE, PLANT SCIENCE RESEARCH DIVISION. THE NATIONAL POTATO BREEDING PROGRAM. The Thirty-Ninth Annual Report to Cooperators. March 1969. Washington, D.C.

PN-2507

FIGURE 1.—Reaction of potato leaves to infection with *Alternaria*.

PN–2508

PN–2509

FIGURE 2.—Screening setup in the greenhouse: *A*, Overall view; *B*, closeup.

TABLE 1.—*Relative resistance of 87 potato varieties and breeding lines to* Alternaria solani *under greenhouse screening conditions*

Variety or line [1]	Mean	Not significantly different (P = 0.05) through mean [2]
B 4269-16	3.50	1.88
BR 6245-4	3.25	1.62
B 6330-3	3.00	1.38
BR 6159-8, B 6024-3	2.88	1.25
BR 6320-1, AB 63131-1, Chippewa	2.75	1.12
BR 6293-12, Teton, Katahdin, Viking, BR 5957-7, and B 6116-18.	2.62	1.00
B 6138-3	2.50	.88
B 6097-9	2.38	.78
Chieftain	2.32	.68
Kennebec	2.25	.62
B 4605-13	2.22	.62
B 4160-1, B 5598-2, B 5647-9, B 5701-21, BR 5960-13, and BR 6321-1.	2.12	.62
B 6044-14, BR 6290-9, BR 6313-3, Alamo, B 5141-6, B 4093-11, WV 48-39.	2.00	.62
B 725-61, B 566-WV 8, BR 5948-1, BR 5967-7, BR 5970-4, BR 6246-1, BR 6290-3, BR 6316-4, and BR 6317-25.	1.88	.62
B 5698-8	1.82	.62
B 5415-6, BR 6246-2, BR 6315-4, BR 6319-20, Saco, and Pontiac.	1.75	.62
B 5647-9	1.62	.62
B 605-10, BR 6287-19, BR 6315-8, BR 6316-5, B 6356-1, B 6345-3, Sebago, Sequoia, Shoshoni, and Snowflake.	1.50	.62
B 6038-1, BR 6317-3	1.38	.62
B 4494-6	1.32	.62
B 751-119, X 792-76, B 5421-3, BR, 5951-3, B 6359-1, Wauseon, Russet Burbank, and B 4088-4.	1.25	.62
BR 6306-22, X 792-96, B 4473-3	1.12	.62
B 5461-4, BR 6250-1, BR 6312-2, Barly Gem, Merrimack, and Rural N.Y. $2.	1.00	.62
X 792-94, B 3331-7, B 6039-1, and BR 6321-10	.88	.62
B 2894-24	.82	.62
BR 6261-1	.78	.62
BR 6260-4	.68	.62
BR 6273-1	.62	.62

[1] Advanced selections from breeding lines in increase plots at Aroostock and Chapman Farms, Presque Isle, Maine.

[2] Means tested with Duncan's Multiple Range Test.

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